PAVING AND MUNICIPAL ENGINEERING

A Journal Devoted Specially to Street and Sidewalk Paving, Sewerage, Water-Works Construction, Street Lighting, and all Matters Pertaining to Municipal Engineering.

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Communications are invited, and all requests for special information on the subjects treated by this journal will receive careful attention.

Articles relating to the different branches of municipal engineering are desired. Stamps should accompany manuscripts for return postage if unavailable.

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CONTENTS.

	PAGE.
Valuable Information from Abroad	77
Differences Between Good and Poor Asphalt.....*Louis H. Gibson.*	77
Specifications for Cedar Block Paving in Minneapolis	78
Information for the Novice About Brick Paving.....*H. L. Weber, C. E.*	80
Official Views on Paving	81
Durability and Cost of Asphalt	82
Macadam, the Roadmaker	83
Proposed Road-Making Machine Contest in Missouri	83
IMPROVEMENT AND CONTRACTING NEWS—	
Paving	84
Sewerage	85
Bridges	86
Water-works	86
Street Lighting	87
SEALED PROPOSALS	87

The columns of this publication are open to the discussion of all subjects relating to paving, sewerage, water-works, street-lighting, and the physical improvement of cities. Practical information as to the merits of materials used in such work and new methods, with photographs and drawings, which may be used for illustration, are especially desired. We are glad to get brief notes as to proposed improvements and the letting of large contracts.

City engineers are requested to send us as early as possible copies of their annual reports, which will be given proper notice.

Articles relating to methods of road making and maintenance are invited.

VALUABLE INFORMATION FROM ABROAD.

MR. LOUIS H. GIBSON, who went to Europe nearly a year ago as a special representative of PAVING AND MUNICIPAL ENGINEERING, for the purpose of investigating public improvement and methods in the leading European cities, has gathered much valuable information, which we will continue to give to our readers from month to month. Mr. Gibson finds that there is even more to be learned than he had supposed, and for the purpose of making his investigations absolutely thorough will prolong his stay till next February. His series of articles in PAVING AND MUNICIPAL ENGINEERING have been generally recognized as of the greatest value, and have been widely copied. Much more useful information, of a character that American readers have hitherto been unable to obtain, is yet to be given. As to the progress of his work, Mr. Gibson writes privately to the editor of PAVING AND MUNICIPAL ENGINEERING from Paris, where he has been stopping for the last several months:

DEAR SIR—Agreeable to your suggestion I have been throwing my energy into the acquirement of knowledge on the subject of asphalt and asphalt paving. I find that it has not been a subject of general investigation by scientists, municipal engineers or others. As far as I am able to learn, from the most diligent inquiry, there has been only one engineer of high character who has given this matter special and systematic attention. The result of his investigations I have been so fortunate as to acquire. The city of Paris has done certain work along this line, but nothing like that of which I speak. Everything that we can gather on this subject I am now engaged in translating, which, together with special information, verbal and otherwise, I am gradually putting into form. I can not think that this work would be done as well by any one less vitally interested in it than myself.

Very respectfully, LOUIS H. GIBSON.

The appreciation of Mr. Gibson's articles has been such as to warrant the enterprise in this direction. The value of the information he is gathering is such that it is not improbable that it will be decided later to put his articles in book form, but for at least a year or more longer the public will have the advantage of getting this knowledge of a subject about which too little is generally known in this country from PAVING AND MUNICIPAL ENGINEERING exclusively.

DIFFERENCES BETWEEN GOOD AND POOR ASPHALT.

By Louis H. Gibson, Our Special Representative in Europe.

BEFORE beginning the study of asphalt it is necessary to define the subject clearly, because usage has introduced between the words asphalt and bitumen a so singular and persistent confusion that it is not possible to speak without risking an equivocation. It is therefore indispensable to restore to each term its exact signification.

Bitumen is a mineral body of a brilliant black with reflects of a reddish color. It is solid at a low temperature, ductile when it is heated a little and rolled between the fingers for several minutes. It is liquid at fifty degrees Centigrade; relatively constant, seeing that if maintained for several hours at a temperature of two hundred to two hundred and fifty degrees Centigrade, it loses hardly one per cent. of its weight. Its density then equals nearly that of water.

Asphalt of good quality is a rock which is brittle at summer temperature and hard during winter. If left exposed during several hours to a hot sun, it falls of its own accord into a brown and oily dust. At a temperature of fifty to sixty degrees Centigrade it is readily broken between the fingers. In color it is a dark chocolate brown, approaching black. Its fracture also resembles chocolate, being granular and irregular, without a plane of cleavage. This differs, however, as to whether it is operated in the direction of the stratification or normally thereto. In the first case it is darker and more farinaceous; in the second, dryer and lighter in color. Different mines have each their particular tone, but the product is always of a chocolate tint, darker or lighter.

The structure of asphalt varies with the bearings. The description given here is of a sample which carries the medium condi-

tions. The grain is fine and homogeneous. The various aspects of the fractures are sensibly the same when the rock is worked in the direction of the stratification. However, sometimes, the rock presents a spotted appearance, being sprinkled with spots a little lighter in color than the foundation color; which recalls the spotting of a tiger. At other times it contains a number of shells about one-eighth inch in diameter, filled with crystals of carbonate of lime impregnated with bitumen the same as the rest of the rock. Again, there are large crystals about one-sixteenth inch each side, but always impregnated with bitumen. All these varieties constitute excellent asphalt, on the sole condition that the diverse parts are completely penetrated with asphalt.

It is this quality which presents the essential element of asphalt rock; it is this quality which has made possible the modern street and sidewalk covering. Asphalt is a carbonate of lime in which each minute particle of the rock has been thoroughly impregnated, by natural means, with bitumen. This will be considered later.

The following are methods by which one may recognize asphalt of poor quality:

Although such a rock is regularly impregnated with asphalt, the bitumen, which acts as a "keeper" and cement, is less than four or five per cent. Under this circumstance the rock is hard and difficult to work. Sometimes the rock is hard and granulated infinitely in a manner to form the necessary grains. The bitumen has introduced itself into the fissures of the rock in such a manner that when it is broken there appears the dark chocolate brown surface which belongs to good rock; but if the rock is crushed and examined with the microscope it is found that the bitumen has only apparently impregnated the rock, and the process is simply an oozing extremely divided in a manner to form a cement only. There is no impregnation proper. In Auvergne are found many samples of this kind of rock.

Sometimes the lime rock, though rich in bitumen and well impregnated, contains elements of clay, which latter substance, though regularly impregnated with the bitumen, breaks the homogeniety of the rock and has often caused the fissures which sometimes occur in street coverings. Nothing is easier than to determine the existence of clay.

Sometimes workings of bituminous limestone contain with the bitumen an oily principle which renders the rock too greasy and injures the consistence of the mastic asphalt. It is possible to take out this surplus of oil by distillation, but the value of the asphalt is injured by this process.

Thus we see that in order to have asphalt of good quality, it is necessary to have the lime rock, every particle of which is thoroughly impregnated and cemented with bitumen, that the bitumen should be in the proper proportion, that it should be of the proper quality, and finally that the rock should be unmixed with clay or other foreign substances, even though they be also impregnated with bitumen.

When an asphalt rock has been exposed to contact with the air during a certain time the bitumen of impregnation is dryed out at the surface for a thickness of $\frac{1}{64}$ inch. This dessication is due to the slow evaporation of the bitumen, which leaves the asphalt of such a color that it presents no difference in aspect from the ordinary limestone. When, however, this rock is broken, it is found to be dark on the interior.

These are the most evident differences between good and poor asphalt. For practical purposes, to assure one of the utility of this rock, nothing will take the place of laboratory work. This belongs to the department of chemistry. It is here that is determined the quality of the bitumen, as well as the proportion which the rock contains, and whether or no there is mixed with the rock foreign substances.

Yet beyond all this must come a practical test. There are rocks which present to the chemist all the conditions of safety, but which will not yield readily or perfectly to pressure, and for this reason are unfitted for use in street work. For all these purposes of trial there are special apparatus in use which it is unnecessary to describe here. It is also unnecessary to repeat the chemical composition of asphalt rock, which was given in the last month's number with sufficient detail to serve our readers, unless they have it in mind to enter laboratory work in connection with asphalt.

We give, for the sake of clearness and because of its general interest, the principal manifestations of bitumen. It is found *free* at the surface of Lake Morte, and as well exists in subterranean masses, from which it is expurged naturally to the surface. A prominent example is found in the fountain of Poix, near Clermont Auvergne, France. Free bitumen is found as well oozing from bituminous rocks which it has impregnated. The workings in Gieti, in Italy, furnish an example of this method of obtaining this substance.

Bitumen is found mixed with other material in three forms: First, mixed with earth usually in the form of clay. Such bitumen is found in Trinidad, Cuba and Mexico. The eruptions are slow and permanent, and the bitumen is mixed with about thirty per cent. of clay and thirty per cent. of water. This mixture will be treated more fully at another time.

Bitumen is also found mixed with gravel in Bastienne, Pyrmont and Auvergne, in France. The third mixture of bitumen is really an impregnation of pure lime rocks, and forms asphalt. This is found in Seyssel, France, Val-de-Travers, Switzerland, Ragussa, Sicily, etc.

Thus we see that bitumen plays a most important part in the formation of asphalt sidewalks or streets. First, it must thoroughly impregnate the lime-rock; and secondly, it is used in its free state in the preparation of the mastic.

The sad experiences which most European cities have passed through from the use of either a poor quality of real asphalt, or an imitation thereof, has led to many expedients for obtaining the proper material. The most radical of these has been to have sent to the place of application the natural asphalt rock, where it was prepared for use by the city or company putting it down. But this is manifestly inconvenient and expensive. It requires an outfit of machinery not alone to prepare the mastic but as well to put it in position. Latterly there have developed companies who have put on the market asphalt which is reliable. The mastic bears the stamp of the company preparing it, and the powder for street use is sent directly to the place of application. No company with an established reputation will ship anything but the proper article. A rock unknown still has its reputation to make. Nothing but a trial, or perhaps repeated trials, can make it safe to use an asphalt rock which is unknown.

Paris, July 21, 1891.

SPECIFICATIONS FOR CEDAR BLOCK PAVING IN MINNEAPOLIS.

WORKMANSHIP.—It is the intention of the city of Minneapolis that the work done under its charge must be first-class, both in respect to material and workmanship, and it is hereby mutually understood that the contractor must furnish suitable tools and employ competent labor to perform the work to be done, and any labor or tools that shall not meet the approval of the city engineer may be ordered from the work by him, and such labor and tools substituted as shall meet his approval.

All material used in the work that may not, in the opinion of the city engineer, be equal to the requirements of the specifications, may be rejected by said engineer and such rejected material must be immediately removed from the line of the work.

Inspection.—In case of any difference in opinion between the contractor and any inspector appointed to inspect the work, as to the meaning of these specifications, the decision of the city engineer shall be considered final, and the contractor shall abide by such decision.

If at any time during the progress of the work, any imperfect material or improper work be discovered in the street, it shall be the duty of the contractor to immediately remove the same, and properly replace it at his own expense.

If, on account of the contractor furnishing a poor quality of material, or labor, it shall be necessary to employ more than one inspector on any one piece of work, the city engineer may employ

such additional inspector as may be necessary to insure a proper inspection of the work, and the expense caused by the employment of such additional inspector will be deducted from any moneys that may be due or may become due said contractor on account of said work.

Notice of any imperfections in the work to any foreman in charge of any portion of the work, during the absence of the contractor, will be considered as notice to the contractor.

It is hereby expressly understood that upon the refusal or failure of the contractor or his men to comply with any portion of these specifications, the city engineer is hereby authorized to employ sufficient labor and purchase sufficient material to have the required work done, and deduct the cost from any money due or that may become due the contractor on account of his work.

The work must progress as directed by the city engineer or his assistants on the work. The contractor shall remove all material and debris from the street as the work progresses, so that the public may have the use of the street as soon as, and as fast as, the work is completed.

Any inspector, appointed for the purpose of inspecting the work herein specified, shall have the right to require of the contractor to conform to the requirements of these specifications.

Street Railway.—Upon such streets as the street railway company has tracks, it shall be the duty of the street railway company to lower its tracks to conform to the grade of the pavement to be laid. The said street railway company in lowering its tracks shall deposit the material excavated on the outside of its tracks, and the contractor will be required to remove the same at the same price per cubic yard as for extra excavation. It is, however, expressly understood that when the street railway company has double tracks the contractor will be required to excavate and pave the space between said double tracks, in the same manner as the remainder of the roadway, and shall receive the same price per square yard for said paving as he shall receive per square yard for the remainder of the paving of said roadway.

Bond.—A bond of not less than twenty-five (25) per centum of the work, nor more than fifty (50) per centum of the work, as the city council may deem best, and in no case less than five thousand dollars ($5,000), conditional upon the full and satisfactory completion of the contract, and to indemnify the city from any damage that may arise on account of the negligence of the contractor in not properly guarding and barricading his work, and placing proper danger signals at dangerous places on the line of his work, will be required of the contractor.

The amount of said bond is to be determined by the city engineer, based upon the quantity of work to be done. The contractor to whom the contract shall be awarded must execute said contract and furnish the necessary bond within two weeks after the city council shall have awarded said contract, and upon the failure of the contractor to execute said contract and bond within the specified time, the preliminary bond submitted with his proposal shall be considered forfeited.

Penalty.—There will be a penalty of twenty dollars ($20) per day for each and every day that the contract shall remain incomplete or unfinished after the first day of November, ——; said penalty will be deducted from any moneys that may be due or may become due said contractor from the city of Minneapolis.

Bidding.—The contractor will bid separately on each street or avenue. The city council reserves the right to let the work herein specified in such manner as said city council may deem to be to the best interest of the city, either by awarding the whole of said work or any part thereof to any one contractor.

Payments.—The work will be paid for upon monthly estimates of the city engineer, reserving ten (10) per cent. of the amount of each estimate until the final completion and acceptance of the whole work under contract.

Extra Excavation.—Any material excavated below the depth of eight (8) inches, together with the material excavated from above the grade of the surface of the finished pavements, will be considered as extra excavation, and be paid for at a price per cubic yard, the contractor to state a price per cubic yard for such extra excavation when making his proposal. In order to determine the lowest bidder the amount of extra excavation will be assumed at one-sixth of a cubic yard for each square yard of pavement.

Grading.—The roadbed must be graded to the uniform depth of eight (8) inches below the top of the finished pavement. If, however, in the opinion of the city engineer, the material at the depth of eight (8) inches is not suitable for a foundation for the paving, the contractor will be required to excavate to such extra depth as the city engineer may require and replace the material so excavated (below the depth of eight (8) inches) with sand of such quality as the city engineer may direct, and any material so excavated, together with the material excavated from above the grade of the surface of the finished pavement, will be considered extra excavation and be paid for at a price per cubic yard, as heretofore stated for extra excavation.

The sub-grade upon which the foundation plank is to be laid must be made solid and compact, either by ramming, rolling or puddling, as the city engineer may direct. Care must be taken not to disturb the material below the surface of the sub-grade (which shall have the same form as the finished pavement), except in cases heretofore specified for unsuitable material for foundation. The right is hereby reserved by the city to require the contractor to deposit any or all the material excavated from the streets or avenues to be paved, upon any street or avenue in any place and in such quantities as the city engineer may direct, provided the average haul of all the material so required by the city shall not exceed one-half mile, and it is expressly understood that all material not required by the city must be wasted by the contractor at his own expense.

Blocks.—The blocks must be of the best quality of cedar, live and perfectly sound, and when in place be free from projecting knots and bark. They must be of a uniform length of six inches and have a diameter of not less than four inches nor more than ten inches. No blocks exceeding ten inches in diameter will be allowed in the work either whole or split, and it is hereby expressly understood that the contractor will not be allowed to deposit upon the line of the work any blocks having the diameter greater than ten inches, or any blocks turned from a post of a greater diameter than ten inches.

It is expressly understood that the contractor will be required to repair in a satisfactory manner any paving that may settle or become defective on account of improper workmanship or material, or on account of the laying or construction of water mains, sewers, gas pipes, or making sewer, water or gas connections, or conduits laying, or any excavations allowed to be laid in the street by the city council, which may have been done previous to the laying of said pavement, without cost to the city of Minneapolis.

Flooring.—Upon the finished sub-grade must be laid a floor of sound, white pine plank, of the quality equal to the grade known as first common lumber, as the city engineer and the city council may determine. These plank must be laid lengthwise of the street with close joints, and be two inches thick, from eight to twelve inches wide and from fourteen (14) to sixteen (16) feet long. They must have a bearing at each end and in the center upon a one inch by eight inch stringer firmly bedded in the sand. Planks not less than six inches wide may, however, be used in order to form the crown of crossings.

Laying.—The blocks must be placed upon their ends in close contact with each other, on a clean floor, the joints between the blocks must not exceed two inches in their longest direction. Blocks of less diameter than six inches must not be split nor must a piece of less size than half a block be used. The corners of split blocks must be trimmed so as to make proper joints. Unnecessary splitting of blocks will not be allowed.

Joints to be Filled.—The joints or spaces between the blocks must be filled in the following manner: First, fill the joints by sweeping clean, screened gravel of a size not exceeding one inch in its largest diameter, into them. After sweeping, the surface of

the pavement must be clean and free from gravel, then the gravel must be thoroughly tamped. This process must be repeated a second time. Gravel of the same kind as before used must be spread over the surface to a depth of not less than one inch above the top of the blocks.

Cross-Walks.—There are to be four cross-walks at each full street intersection, and three at each half intersection. They are to be ten feet wide and constructed in such a manner as the city engineer may direct.

Gutters and Corners at Crossings.—Must be made as follows: The outside plank shall be 3 inches thick, 16 inches high, and 20 feet long on 80 feet streets, and 3 inches by 16 inches by 16 feet on 60 feet streets, and held in place by not less than 6 posts of 3 by 6 by 30 inches, driven to a depth of three inches below the top and equidistant along the length of the plank. There shall be a plank, 2 inches thick, 10 feet long, for 80 feet streets, and 2 inches by 8 feet on 60 feet streets, and of a width of 3 inches less than the depth of the gutter, placed against the curb to support the gutter cover which shall be made of two pieces of 3 by 12 inches by 10 feet on 80 feet street, and 3 by 12 inches by 8 feet long on 60 feet streets, fastened together with four pieces, 2 by 6 by 19 inches, well nailed with 6, 30 d. spikes to each piece. The top of the outside gutter plank on the slope of the crossing shall be trimmed to conform to the top of the paving. In making proposals the contractor will state a price which shall include cost of excavating eight (8) inches below the top of the finished paving; also the furnishing and putting in place complete of all lumber required in the gutter crossings and covers. The contractor will state a price per cubic yard for extra excavation.

INFORMATION FOR THE NOVICE ABOUT BRICK PAVING.

By H. L. Weber, C. E.

THE time has arrived when the paving of the roadway of our cities and villages with brick has ceased to be an experiment, and the day is not far distant when our enterprising farmer will see the advantages gained by having a good roadway, and brick streets will extend many miles outside our city boundaries. But in order to make a good brick pavement, it is necessary to have good material, and very essential that good work should be done, for the best of material and poor work can not and will not make a good street. Great progress has been made in the past dozen years in brick paving.

When John Porter, who might be called the father of brick paving, first laid his experimental pavement, out of hard-burned semi-fire-clay that was a refuse around his yards, he had no idea it would wear as long as it did. But wearing as it did, it induced further experiments and the results were so favorable that to-day instead of using the refuse or the brick that are too hard burned for fire-brick, for street purposes, there are many factories manufacturing brick for street paving, and the brick manufactories found it necessary, in order to fill the demand and meet the requirements of the engineer's specifications, to make a better kind of brick, instead of using the hard-burned fire-brick. How near they are doing it, I will demonstrate later on, as I wish to treat the pavement from the foundation up.

The sub-grade should be constructed to conform to the finished surface of the roadway. It should be rolled with a steam road-roller weighing from ten to fifteen tons. This roller should pass over the entire surface a sufficient number of times to thoroughly roll every portion of it, and when completed should show no unequal settling, but a continuous smooth surface. The sub-grade should then be coated with a layer of crushed, unscreened sand or limestone. These stone can be put on in two layers; the first may be large stone, from the size of an ordinary building brick, down, and should be spread evenly over the entire surface; boulders, brick or spawls for this course will do. In fact, almost anything will do that will not decay—cinder or furnace slag. Upon this layer may be placed crushed stone or gravel and stone to a depth that, after it has been thoroughly rolled, will measure six inches; for very heavy traffic the depth should be eight inches. The rolling of this foundation must be thoroughly done, and when finished should be true to a grade, six inches below the surface of the street when finished. This is by far the most particular part of the work, and if not well done the pavement will show unequal settling. This foundation can be constructed of gravel and sand, should there not be stone or other material in the locality to be had, with equally as good results. Upon the foundation there should be equally looted off a layer of good sand two inches in depth I do not care what kind of a foundation is used—concrete, stone, sand or gravel this two inches of sand should be used, and it should be the best of sand, as it is intended to form a cushion for the paving brick. Upon this layer of sand should be placed the brick on edge in even, straight courses across the street and at right angles to the curb care being taken to break joints, as near as is practicable, in the middle of the brick in the preceding course. At street intersections they should be laid "V" shape, or at an angle of 45° from the other brick or curb line, beginning at the middle of the intersection, or middle of the work, and should be built out to the center of the intersection, then from there to each side or a line cutting the curb line on all sides.

When the brick have been laid for a distance of two hundred feet or more, spread over the entire surface about one half inch of sand, which should be allowed to dry, and then thoroughly broomed into the joints, and filled to the surface. A large sprinkling of water after this operation is beneficial; or, the sand can be flooded in with water, care being exercised not to put on too much with too great a force, so as to have a tendency to wash.

After thus treating with sand, the pavement should be rolled with a horse-roller, weighing at least five tons, the first time over, and seven tons the second time over. The rolling operation should begin in the center of the street. Then roll to the curb, then back to the opposite curb, then back to the center. The roller should be weighted. Continue the operation of rolling until there is no giving under the roller and the surface presents a smooth and continuous surface. Then coat the surface with about one-third to one-half inch of good sand, or, instead of using sand, fill the joints with a cement grout or paving pitch, consisting of pitch and coal tar, or dead oil, care being exercised not to use any more oil than is absolutely necessary. The pitch should be heated to at least 300° F. I would prefer to have 500 to 600 feet of street laid before rolling, as it can be much better done.

It is necessary to have a curb, which can be of sandstone. There are other stones that would do, but if of sandstone they should not be less than three inches thick, eighteen inches deep and thirty-six inches long. A larger curb is better. They should be dressed on end to one-half their depth, and on back three inches down their face, from a point two inces below the bottom of the brick to the top, and set in six inches of sand, fine crushed stone or gravel. Six inches under this curb should be placed a four-inch drain tile, running the entire length of the street or curb, connecting with sewer inlets, etc. This tile has a twofold mission to perform: 1st, to carry away the water; 2d, as a conductor of frost. A curb set in this way will always keep its alignment.

The brick or block should be thoroughly vitrified. Between sixty and seventy should be a square yard. They should not exceed four inches, and should be not less than three and one-half inches in depth. Their shape and size should be the same as the standard line building brick, or as near it as is practicable to make them, as in making them that size you will get them more uniform in burning, more even and thoroughly vitrified. The loss will be less, the drying better done, and the cost of manufacturing less. The clay should be put through a dry-pan and thoroughly pulverized. It should then pass through the screens to the pug mill, where it should be thoroughly pugged in wet pan or pug mill before shaped.

Brickmakers can not economize on this line, for when it comes to manufacturing pavers, it is like making bread; good flour, good kneeding and mixing, good baking, good bread. So with pavers, good clay, good pugging and drying, good burning. The result is a

good paver. The paver should be made side cut, so as to give a rough side, which affords the best bond possible; no creases, grooves, lugs, or round corners are required.

In making a good roadway you must have a continuous surface. When the manufacturer cuts off the corners, he simply cuts off what it would require five years' traffic to accomplish on a vitrified brick street. So when completed you have a street five years old, and a rough street at that. The crude idea some people have that the brick or paver must have a round corner, knobs, lugs and grooves on it, to keep the brick apart, so it can be filled with pitch, concrete or sand, in order to get the required alignment is absurd, and is not at all practicable.

The waste brick that are not suitable for pavers, in the manufacturing of this kind of a paver, are thrown in the dump, as they are an odd size and shape and can not be used to any advantage for other purposes. Therefore their cost to manufacturers must be added to the price of the good paver or the manufacturer will lose money. Were they to manufacture a paver the same size and shape of the standard line brick, all pavers not suitable for paving purposes could be utilized for building purposes; the manufacturers can thereby at least get the cost of manufacturing out of them, which will reduce the cost of the good paver to the consumer and give them the best and the most practicable paver it is possible to make.

Some put grooves in their blocks, endeavoring to overcome the smooth surface and create a bond, but it is a failure. The glazing is put on to make them look nice, fill up the cracks, and make them appear hard, and deceive the engineers and property owners. The manufacturers are too anxious to get rich, and will manufacture any size, shape or form any patent crank may ask for, regardless of what is actually needed. One manufacturer said, not long ago, "Why dictate to the people what they need? Make them what they want, so you get well paid for it." If I were a manufacturer I would make the best and most practicable paver it was possible to make, which, to my opinion, is a brick 8½x4x2½ inches, side cut, and take my chances of selling them.

OFFICIAL VIEWS ON PAVING.

THE annual report of the Omaha Board of Public Works, composed of P. W. Birkhouse and John B. Furay, is devoted chiefly to a discussion of the paving problem, in which the opinions of the board, based on experience, are very fully set forth. On the subjects of brick and asphalt, the board says:

"In the matter of brick paving, what seems to be required is a thoroughly burned, non-porous brick, that is not only hard but tough, as a porous brick absorbing moisture will disintegrate under the action of the frost, while other bricks, although very hard, will fly to pieces under the action of the horseshoe. As yet there is no standard of merit established, as the result of experience indicating what should be the qualities noting the excellence or inferiority of any special kind of brick, beyond the apparent necessity that they shall be *hard and tough.*

"The people interested in brick manufacture have been and are yet actively engaged in experimenting with our native clays, and it is due to them to state that much progress has been secured, as already we have had presented specimens of a brick manufactured in a neighboring county that seems to be superior to any heretofore used by the city.

"These specimens are made in four by five by twelve inch form. A regular block, with beveled edges, and if a supply of this material can be obtained, of uniformly good texture, such as the specimens we have, then it occurs to us that on residence streets where a cheap, smooth, cleanly pavement is required, this quality of brick would certainly justify an experiment, as they can be laid upon a sand base, and from their regular and perfect form would certainly assure an even contour of street surface which can not be hoped for from stone, and therefore give more noiseless pavement —akin to the sawed granite, known as "Belgian Block," pavements of eastern cities, and for but a small part of the expense.

"Brick pavements are easily repaired and without great expense. They seem well calculated to replace wooden blocks, on concrete base, as it will bring the surface of the street to its former level.

"Great care must be taken in selecting this material, and it is yet an open question whether brick as a paving material is a success, owing to the great diversity in the clay from which bricks are made, and also the great difference in our climate from that prevailing in other cities, making the experience gained in one place with the same brick of little use in another. We can not make a good comparison with some cities which claim that brick has been a success, as we have more traffic and cleaner streets.

"This city is able to speak authoritatively upon asphaltum as a paving material, as we have more of it than any other city in the world according to population. Newly laid Trinidad sheet asphaltum is beyond all question the finest appearing material in use for paving, combining as it does so many desirable properties. It is smooth, noiseless, easy to clean and keep clean, impervious against absorption of all matter deleterious to health, as well as preventing unhealthful exhalations from the earth in the surface covered; is capable of being laid in almost any form of adjustment to adjoining material, and while dry and unfrozen is not slippery. These are its merits of excellence, but with other materials it is incumbered with many objectionable features.

"To start with, it is very expensive in any and all its forms, heretofore being entirely in the hands of a corporation known as the Barber Asphalt Paving Company, who have faithfully wrung from the public the very highest price possible to obtain, and while during the past eight years in our city, the prices of paving with all other kinds of material have been reduced from twenty-five to fifty per cent., this monopoly has been able to maintain the original prices; thus preying upon the public simply and only because they controlled and monopolized the situation.

"The commercial value of the materials entering into the composition and formula and methods of mixing are well known.

"Asphalt cement is composed of refined (or commercial) asphaltum, eighty-five per cent.; residuum, fifteen per cent. 'Residuum' in common language is simply the cheap settlings resulting from the distillation of coal oil.

"The wearing surface of asphaltum paving consists of:

Sand	About 83 per cent.
Asphalt cement	12 to 15 per cent.
Carbonate of lime	5 per cent.

"The 'carbonate of lime' used is simply unburned limestone, crushed and ground to about the consistency of fine corn meal.

"The 'standard mixture' used in this city is prepared in boxes, and the precise formula for each box is as follows:

Missouri river sand	679 pounds
Asphalt cement	135 pounds
Carbonate of lime (stone dust)	98 pounds
Total	902 pounds

"Five of these boxes make one cubic yard and weighs 4,510 pounds. This will lay the wearing surface of paving, according to inspection reports, as follows:

Class, Form 10 'A,' 2½ inches thick	12 square yards
Class, Form 10 'B,' 2 inches thick	18 square yards
Class, Form 10 'C,' 1½ inches thick	27 square yards

"One ton of commercial asphaltum makes 2,300 pounds of asphalt cement, which amounts to 3.4 cubic yards of 'standard' surface material, or in other words, one ton of commercial asphaltum, costing less than thirty dollars, will lay 'topping' as follows: Class 'A,' 40.8; Class 'B,' more than 61; and Class 'C,' more than 81 square yards. The cost to the city of the pavement complete, is $2.98, $2.68 and $2.48 per square yard for Classes 'A,' 'B' and 'C,' respectively. The Missouri sand and the pulverized limestone, obtained from our local quarries, can be estimated by all, as well as the labor, etc. Comparing the cost with the prices our people have been paying, leaves a profit of such magnificent proportions

as to greet with pleasure the report that the future promises a hope that this monopoly will be broken, securing the construction of this kind of paving at a net profit to the contractors of not more than twenty-five per cent. to fifty per cent., and doubtless at about one-half the cost our people have heretofore been paying.

"Asphalt paving requires careful and constant repairs, and these repairs can only be made by the Barber Asphalt Company, as they alone can afford to maintain a plant here. Where it is necessary to open the streets for private or public sewers, water or gas connections, or for any other purpose, the cost of such repairs are simply excessive. Our citizens are forced to submit, as this company alone controls the situation.

"Inasmuch, as after five years from date of acceptance of the pavements, this company alone can execute the constant and much needed repairs, incident to its continual dilapidation, our city government is compelled to enter into long-time contracts at a given price per square yard per annum. Our present existing ten years contract is at the rate of 8 cents per square yard per annum for all asphalt laid, whether requiring repairs or not. That our people may understand just what this costs, we will assume an ordinary residence lot 66x132 on a street 100 feet wide, with sidewalks 20 feet in width, leaving 60 feet between curbs. Such a lot pays for 220 yards at 8 cents per yard, equaling $17.60 per annum repairing tax alone, which this board regards as exorbitant. One owning a corner lot with this material upon both streets, the annual taxes for repairs only are $52.80. Nor has the expense been still all estimated—the intersections of the streets and alleys have yet to be included and paid for at the same rates by the city at large.

"When the extravagant first cost of this paving is added to this repairing tax, our citizens, we believe, will carefully consider the expense they are assuming in selecting asphalt paving until these prices are reduced.

"Again, where asphaltum is used, the base is of but little if any value for any other form of paving that may become necessary to replace it, as the top of the base lies only from 1½ to 2½ inches below grade surface, as the thickness of the wearing surface may be, and hence neither brick, stone or other material can be reset upon the base, as it would raise the grade surface 3½ to 4½ inches too high for the curbs. This means that a street once prepared for asphalt paving shall always so remain, except at the total loss of all the money expended thereon.

"Water is the mortal foe of asphalt pavement, as it rapidly disintegrates under continued moisture, and when the streets are being sprinkled, or the surface is frozen, it is very slippery, even upon level streets. Upon streets carrying more than 4 per cent. grade it is dangerous, and in the winter season, on account of its inclination to wear away the shoes, it is almost impossible to keep a horse sharp shod, so as to travel with safety."

[An answer to the foregoing by the Barber Asphalt Company was expected in time for use in this issue. Capt. Greene, the vice-president and manager of the company, says that testimony can be submitted disproving some of the statements, and he hopes to have ready for the October number a complete reply to the remarks of the board, so far as they relate to his company.—EDITOR PAVING AND MUNICIPAL ENGINEERING.]

DURABILITY AND COST OF ASPHALT.

THE Chicago *Tribune* has been advocating asphalt pavements for the streets of that city, and has been gathering information as to its advantages. In a recent issue, an interview with Mr. V. W. Foster, of the Western Paving and Supply Company, is given as follows:

"Engineer Charles H. Bull, who was sent abroad by Commissioner Gilroy, of New York, to investigate the merits of asphalt, said: 'The life of an asphalt pavement, if kept in good repair, is considered to be from seventeen to twenty years. Threadneedle street, Cheapside, and Poultry in London, which were laid about twenty years ago, sustain an enormous traffic. In the twenty-four hours of Feb. 21, 1888, 13,772 vehicles passed over the asphalt pavement in Cheapside, and 23,332 teams over the same kind of pavement on Mansion House street during twenty-four hours of the following day."

When asked what was the average cost of maintaining asphalt pavement, after the expiration of the five years usually guaranteed, Mr. Foster said that he would agree to keep in repair any Trinidad asphalt pavement, properly laid, for 10 cents per square yard, per annum; but that he would not advise any corporation to accept such an offer, as statistics showed that it did not cost over half that amount. He further stated that in June his firm made the first repairs on Dearborn avenue, between Chicago avenue or North avenue, that had been made since 1889, and that their entire bill for the work was $8.33. To illustrate the small cost of maintaining Trinidad asphalt pavement after the expiration of the contractor's five-year guarantee, Mr. Foster showed the report of Capt. Griffin, made on this subject in 1889. Capt. Griffin was city engineer of Washington, D. C., and these figures relate to the cost of maintaining the asphalt streets of that city after the first five years.

Year in which laid.	Number of yds. laid.	Guarantee expired in.	Cost of Repairs from expiration of guarantee to July 1, 1886.	No. of years after guarantee.	Average cost per year.	Average per yard per year.
1876	54,000	1879	$9,764.05	7	$1,394.86	$0.025
1877.....	2,000	1880	93.76	6	15.61	0 007
1878.....	84,935	1883	6,930 07	3	2.310 02	0 026
1879.....	127,641	1884	493.49	2	246 74	0.002
1880.....	87,600	1885	709.52	1	709.52	0.013
Totals ..	356,176				$4.676.75	$0.013

That is, the average cost to the city of maintaining these pavements after the guarantee period is 1⅓ cents per square yard per year.

On 8,000 yards laid in 1878, 81,000 yards laid in 1879, and 84,000 yards laid in 1880, the City of Washington has not expended anything for repairs.

In illustration of the statement that asphalt is the cheapest pavement in the long run Mr. Foster quoted an extract from the engineer's report of the South Park commissioners, showing the cost of construction and maintenance of the Michigan avenue macadam roadway as follows:

"In the volume of 1882 on page 24 we find that the cost of construction of pavement was $2.60 per square yard. In the next year, 1883, we find on page 23 the engineer reports that from Park place to Twenty-eighth street they had taken off the gravel and had the top dressed with three inches crushed granite at a cost of 50.6 cents per square yard. In the 1886 report we find on page 17 that from Fourteenth street to Twenty-third street it was again top dressed at a cost of 63 cents per square yard. Here, then, we find in six years (a street where nothing but pleasure driving is allowed) a cost of $3.73 per square yard.

"The amount of saving in the one item of traction," continued Mr. Foster, "to say nothing of the freedom from noise and other good qualities of asphalt compared to granite blocks, will be worth $3,000,000 annually to Chicago. Captain Francis V. Greene, one of the most eminent road authorities in the world, says on this point:

"'For instance, in the City of New York it is estimated that there are 12,000 trucks, carrying an average load of one and a half tons for twelve miles on each of 300 days in the year, at an average daily cost of four dollars for each truck. The result is about 65,000,000 tons transported one mile in every year at a total cost of $14,400,000, or at the rate of over twenty-two cents per ton a mile. The excessive nature of this charge is seen when it is remembered that the same goods are now carried by rail at six-tenths of one cent per mile. On asphalt or wood pavements the same horses can transport a load three times as heavy as on the present rough stone pavements. If the saving in transportation is proportional to the load carried it would amount to nearly $10,000,000 per annum. It is safe to say that at least one-half of this amount would be saved by substituting smooth pavements for those now in use in New York.'

"The same authority gives the following comparison as to the

cost of construction and of maintaining for fifty years granite and asphalt pavements:

	Granite.	*Asphalt.*
Cost of construction	$4 60	$3 75
Interest at 3 per cent. and sinking fund at fifty years	27	22
Annual maintenance	04	10
Three renewals of surface at $2.50 $\frac{2.50 \times 3}{50}$	15	
Four renewals of surface at $2.25 $\frac{2.25 \times 4}{50}$		18
Total per year	46	50

"These figures," said Mr. Foster, "will apply equally well to Buffalo, Chicago, or any other city in this latitude.

"As to the superiority of Trinidad over other kinds of asphalt, I can not explain it from a chemist's stand-point; but from the practical experience of ourselves and others, I would not lay any other kind of asphalt now used in America, on which a guarantee is required, for any price. In the city of Omaha the Barber company has entered into a contract to keep the asphalt streets in repair for the second five years at eight cents per square yard per annum, and in my opinion the Barber company has made a good contract, as I do not think it will cost over half that amount.

"The same difference exists between the Trinidad asphalt and all others, as exists between annealed glass and glass not annealed. All other asphalts come from mines, while Trinidad comes from a lake in the island of that name. Here the substance has been thoroughly tempered by the sun and elements. Other asphalts are always mixed with lime, sand, or other materials, and there is no known process by which they can be made homogeneous. Some portions of this substance, which is mined in lumps, have more of the bituminous pitch than others. The result is that when laid some portions of the work might contain six per cent. of the bitumen while others would contain fifteen. Trinidad asphalt is tough and ductile, while all other so-called asphalts that I know anything about are brittle. As a business-man I think it a good business risk to guarantee Trinidad asphalt and a poor business risk to guarantee any other kind."

MACADAM, THE ROADMAKER.

PHILANTHROPY finds many forms, says the Kansas City *Star*. Some who are good at heart go about relieving this man or that in a sort of a retail benevolence; others, whose natures are wholesale, are generous to a nation or a race.

John Loudon Macadam, that canny Scot who made the famous pavement of his name, was of the latter class. Macadam was born in Ayr in 1756 and lived to be eighty years old. When only fourteen he left the land of wind and heather and came to New York, abiding with an uncle already some time there. This befell in 1770. Here he was when the revolution broke out, and, being of obdurate tory blood, his faith was with the king. This had its reward, too, as in the latter part of the war and during British occupation of New York he became agent for the sale of prizes at that port. This was a good, fat place, and his fortunes, planted so in the warmest, cosiest corner of the wall, waxed mightily. So the young Scot grew fortunate and rich, but in the peace of '83, when, with others of his brood, he was forced to leave, he lost the major part. However, he brought home to Scotland enough and plenty to purchase an estate in his native Ayr, and pay quite a bag of doubloons for it, too.

It was now that his eye first fell in appreciation on the awful roads of his country. Government, noting this, appointed him a trustee of roads. Now did Macadam enter into the matter of good roads with great spirit, and began zealously to study their construction. In 1798 he was forced to give over roads for a time, being called on during the following four years to pay some heed to his country's navy in the office of inspector; but at the close of his term, in 1802, he returned to the beloved study of the turnpike.

He traveled all over England and the south of Scotland at his own expense, with no other purpose than roads. This running about he kept up for some thirteen years, and until he had covered in his journeys over thirty thousand miles and expended more than as many thousand dollars.

Roads were a fad with Macadam, and to be permitted to gaze on them and wallow through their mud and mire at a cost to himself of a dollar a mile was as good and cheap amusement as he wanted. But, while he was jolting about over bad causeways and abiding at bad taverns, Macadam was thinking and planning and scheming, and the purpose thereof was roads. Every jolt, every lurch, as he rolled along in his carriage, gave him an idea.

In 1811 he embodied his views in a communication and unloaded it on the helpless house of commons of that day. "How to Repair Roads" was the subject, and he dealt with it clearly and vigorously. Four years later the powers gave him a chance on the roads about Bristol, and here was put in the first of that sort of paving now renowned the world over as macadam.

Macadam's work was mainly in the country, and the buxom agriculturist of his day and region gave him great trouble. These fought and opposed him tooth and nail, after the manner of men when one attempts their benefit. Mankind learns slowly, and the farmers and traders about Bristol preferred their roads of mud and mire on their way to market rather than the good hard pathway of Macadam.

But the Scotchman persisted, after the shock-headed fashion of his sort, and at last conquered. He and his roads began to be appreciated. When the revulsion came in his favor it came without a limit. Everybody, everywhere in England, wanted a macadam road. Plowing, and grading, and rock crushing were gone about in earnest and with such good effect that when the old roadmaster died in 1836, at the age of eighty, it was said that of the thirty thousand miles of country roads which laced and threaded England fully ninety-nine per cent. were macadam.

At divers times parliament voted to Macadam an aggregate sum of thirty thousand dollars. This scarce matched his actual outlay, so for his time and genius he was never paid. But his fame lasts, and his name is written as one of those who lived for general good. His monument is the roads of England.

PROPOSED ROAD-MAKING MACHINE CONTEST IN MISSOURI.

THE State Board of Agriculture of Missouri has arranged for a friendly contest of road machines or graders of various types, to take place in Mexico, Mo., on September 15th, 16th and 17th. Prof. Hiram Phillips, professor of civil engineering in the University of the State of Missouri, will assist the board in this trial in all that applies to the mechanical construction of the graders, capacity for work, draft, etc., and a committee of experts in practical road-making, will pass upon the merits of the several machines and their efficiency in work performed.

The board has issued a circular calling attention to the points to be considered in the coming trial. These points are interesting as showing what is required of a modern road-grader, and are as follows:

"General construction: Quality and class of material; mechanical proportion of parts; durability; draft; ease of management and adjustment for various kinds of work; ability of machine to do its own plowing; borrowing from banks outside of wheels; making ditches; filling ditches; moving earth either right or left, ordinary work; moving earth either right or left up steep slope; moving earth straight forward and down hill; working side hill, borrowing from one side filling other; behavior of machine when working gravel or stony hills, hard clays, gumbo or hard packed roads; acute working angles of blade; position of blade to ground and ability to scour or shed earth; freedom from choking in high grass, weeds, heavy, sod or wet ground; freedom from sliding or slipping sideways; average distance earth is moved at each successive round from bottom of ditch to center of grade; capacity of machine to build a given amount of road in given length of time; quickness of action and power applied to blade by levers used.

Improvement and Contracting News.

PAVING.

Cedar Rapids, Iowa, is paving.

Council Bluffs is paving with asphalt.

Bloomington, Ill., is a brick-paved city.

Chattanooga, Tenn., is paving with asphalt.

Austin, Texas, is improving Eighteenth street.

Kansas City will pave Olive street with asphalt.

Aurora, Ill., is macadamizing some of its streets.

Massillon's (Ohio) streets will be paved with brick.

Columbus, Ga., is laying a new sidewalk on Bever street.

Savannah, Ga., is considering the advisability of asphalting Bull street.

Menominee, Mich., is expending about $50,000 in cedar block paving this year.

Covington, Ky., has signed a contract for asphalt paving to be done in that city.

Rock Island, Ill., is having some Galesburg brick paving done by Edwards & Walsh.

Cheyenne, Wyo., is to have 2,500 feet more of new sidewalk laid on O'Niel street.

P. L. Maloney is laying 25,000 square yards of brick paving in Parkersburgh, W. Va.

N. Gore & Co. will lay a granite block pavement on Tremont street, Boston, Massachusetts.

The paving boom continues at Pine Bluff, Ark. Main street is being paved with brick.

Boston has appropriated $800,000 for a boulevard two hundred feet wide and two miles long.

Permits have been granted for laying over three miles of cement sidewalk in Oakland, Cal.

About $225,000 worth of street improvement work will be completed in West Duluth this season.

New Albany is paving Madison avenue, having entered into a $45 000 contract with the Trinidad Asphalt Company.

Steven's Point, Wis., has just completed 10,000 square yards of cedar block pavement, which was duly accepted.

The bids for paving East Fourth street, St. Paul, with cedar blocks were rejected. Considered excessive by the board.

Work has begun on the grading of Main street, west of Kingston, preparatory for macadamizing, at Caledonia, Minn.

Asher & Parlan were awarded the contract for the improvement of Waldron and Russell streets, in West La Fayette.

It is said that nothing less than a circle boulevard, with shade trees and flowers, will satisfy the mayor of Denver, Col.

The contract for grading and boulevarding Park avenue, from Water-works park to Main park on the lake shore, Milwaukee, Wis., was awarded to Michael Dunn.

Work is being pushed vigorously on the granite block pavement which is being laid on French street, Wilmington, Del.

The city council of Ottawa, Canada, has authorized an over-draft of $20,000 by the board of works for street improvements.

Curbing has been supplied, preparatory to laying the asphalt pavement, for all but three blocks on Moss avenue, Peoria, Ill.

Mrs. Harriet E. Flint, of Wakefield, Mass., has presented that town with $1,050 to be expended upon roads and sidewalks.

A splendid job of street grading is being done at Renwick, Iowa, by Slaight & Co., of Goldfield, with their road grader.

Contracts for paving Calder and Bowery streets, Grand Rapids, Mich., have been awarded. Cost, $3,249 and $5,300, respectively.

The old council of Spokane, Wash., let the contract for the grading of Adams street to Riverside avenue, to Clark, for $9,000.

The mayor and clerk of Lansing, Mich., have entered into a contract with Thomas Farrell for grading Beech street; cost, $3,000.

The property owners on Main street, Danville, Ill., are greatly elated over the first-class job of paving done on that street.

James Hurley has entered into a contract with the city of Marion, O., for a large amount of paving. The contract price is $22,000.

Some $32,000 will be expended in paving Mitchell avenue and Fifth street, Detroit, Mich., with cedar blocks. Medina curbing is to be used.

The Ohio Paving Company will pave the roadway over the railroad tracks on Fourth street, at Columbus, Ohio, with Hallwood block.

Much has been done in the way of paving the principal thoroughfares of Kalamazoo, Mich., this summer, and work has not yet ceased.

Fox & Drexel have been awarded the contract for paving the streets of Omaha, Neb., with form "A" of asphaltum, at $2.70 per square yard.

North Delaware street, Decatur, Mich., has already quite a strip of substantial new sidewalk laid, and the good work is still going forward.

The Southern Construction Company is making preparations for paving Montgomery avenue with Hallwood block brick, at Chattanooga, Tenn.

Six-inch cedar blocks will be used by the Garden City paving and Post Company, of Chicago, in paving the streets of Elgin, Ill. The cost will be $33,712 25.

The finishing touches are being put on the Pine street paving, and work has begun on the paving of Main street, west of Washington, Des Moines, Ia.

Doylestown, Pa., is to have a twelve-inch Telford road on three of the prominent streets leading to the new railroad station and will repair the macadamized road on Washington avenue and Chancellor street. Messrs. Kent & Berger, of Paoli, Chester county, are doing the work.

Logansport, Ind., is putting down many new cement walks along the principal streets, and will soon have the best paved sidewalks of any city in the state.

Street Commissioner Holbrook is putting the streets and sidewalks of Bangor, Me., in good condition; concrete sidewalks are being laid and the streets graveled.

The Portland Bituminous Paving and Contract Company has been awarded the contract for improving Washington street, Portland, Ore. Its bid was for $36,270.78.

The town of Roseburg, Ore., made over $100,000 worth of improvements in 1889, another $100,000 in 1890, and the year 1891 will add a larger sum to the growth of the town.

The "road congress" which it is proposed to hold in Atlanta, Ga., on the 29th of October, is receiving attention in other states. Every state in the Union should be represented.

Mr. Felix Polk, of Princeton, Ind., has entered into a contract with the village board of Albion, Ill., to establish the grade of all the streets of that city for the sum of $200.

Macadam is coming rapidly into favor in Denver, Colorado. Eighteenth avenue is to be macadamized from St. Joseph's hospital to the City Park, at the expense of property owners.

The Ross Sapless Block Paving Company, East Side Saginaw, Mich., has just closed a deal for about ten thousand square yards of sapless-blocks for Wayne street, in South Bend, Ind.

The Western Paving and Supply Company have been awarded the contract for asphalting South Tennessee street in Indianapolis. The pavement is to run from Washington to Louisiana streets.

The paved streets of Scranton, Pa., will be cleaned by Daniel Hays and F. S. Warren: Asphalt, 40 cents; wood, 75 cents; brick, 75 cents, and cobble-paved streets at the rate of $2 per 1,000 square yards.

Curbing is an essential part of paving, and the top of the curb should always be kept at a uniform height—a fact which should always be remembered by the board of public works and the city engineer.

Dodgeville, Wis., thinks it more economical to have good walks and natural light than to have bad walks and institute artificial lights; therefore, quite a lot of new sidewalks have been laid in that city.

The merchants on Main street, in Memphis, have protested against the use of granite in paving that thoroughfare, and have adopted resolutions favoring brick or asphalt, and are very emphatic in their demand for it.

Estimates of over $40,000 have been completed and handed into the board of public works of Seattle, Wash., to be spent on Division, Joy and Black streets. Over $30,000 of the amount will be spent on Division street.

The Ottawa Fire Clay and Brick Company, of Ottawa, Ill., have been so pressed with orders that it has become necessary to double the capacity of their plant in order to meet the increasing demand of their business. They will purchase new machinery.

As Rampart street will, in the near future, become a great thoroughfare for passengers arriving over the Illinois Central Railway, New Orleans is considering the advisability of paving it from Howard avenue to Canal street.

Two hundred thousand dollars will be expended in paving the boulevard at Detroit, Mich., on which work has been commenced. Mr. James A. Randall, at the handles of a plow drawn by two large horses, turned the first furrow.

San Jose, Cal., is undergoing a siege of renovation. New streets are to be opened, new sidewalks laid, new bridges built, new electric railroads constructed, shade trees planted, and everything that is possible to beautify and improve the city is to be done.

A number of cyclists, of Detroit, Mich., have signed a petition for paving with Trinidad asphalt, instead of brick, the Grand River avenue. The signers are business men who daily use the bicycle as a means of conveyance to and from their business.

Before awarding the contract for the paving of Champlain street, Detroit, Mich., the board of public works will make another test of Congo brick, the kind which the lowest bidder, Jesse H. Farwell, wishes to use. If the brick is found satisfactory, Mr. Farwell's bid will be recommended for acceptance.

The Pacific Paving Company contracted for the laying of five miles of asphaltum sidewalks, eight feet wide, in Salt Lake City, in ninety days. This city is also laying some granite pavements, the granite for which is taken from the mouth of Little Cottonwood canon, and is said by Boston and Maine men, who are familiar with granite, to be the best for paving purposes they have ever seen.

Alternate bids for Vitrified Fire-Clay Brick Pavement, Asphalt Pavement and Telford-Macadam Pavement, will be received by the city engineer of Dunkirk, N. Y. The amount of work to be done, and materials furnished is approximately as follows: Excavation, 2,700 cubic yards; pavement, 7,300 square yards; curbing furnished and set, 3,100 lineal feet; circular curbing corners, 69 lineal feet; stone cross-walks, furnished and laid, 760 square feet; stone cross-walks taken up and relaid, 1,050 square feet; four inch tile drain furnished and relaid, 3,300 lineal feet.

Contracts for paving the various named streets of St. Louis, Mo., were awarded as follows: For reconstructing with granite blocks, St. Charles street, Allen & Vieths, $10,609.50; for reconstructing with granite blocks, alley in city block No. 139, Skrainka Construction Company, $2,576; for reconstructing with granite blocks, alley in city block No. 902, Allen & Vieths, $1,391.50; for reconstructing with granite blocks, alley in city block No. 915, H. Ruecking & Co., $2,364; for reconstructing with granite blocks, alley in city block No. 180, Allen & Vieths, $1,070; for reconstructing with granite blocks, alley in city block No. 489, Allen & Vieths, $1,761.

The Stradamant asphalt pavement which was laid on First South street and the State road, at Salt Lake City, Utah, constructed of 4½ inches of gravel and asphaltum, twelve parts sand and gravel to one of asphaltum; a top-dressing of 1½ inches of five parts of asphalt and one of sand, stood the following test a few days after being completed: A dray loaded with 18,000 pounds of bar iron, 6,500 pounds of pig lead, 38 men averaging 150 pounds each, and the truck weighing 3,000 pounds, was driven over the pavement. In one place the wheel made a depression of a quarter of an inch, and at another place, where the wagon came to a standstill, the pavement was broken. However, it stood the test admirably, and the owners are very enthusiastic over it.

SEWERS.

The new sewerage system of Athens, Ga., is completed.

Lawrence, Mass., has built a new sewer on Atkinson street.

New sewers at Flint, Mich., are in process of construction.

Peoria, Ill., is constructing sewers on Main and Fulton streets.

Menominee, Mich., is putting about $100,000 worth of sewers in this year.

A new sewer is being constructed on Montgomery street, Fort Wayne, Ind.

The city council of Monmouth, Ill., passed an ordinance for a system of sewerage.

Lowell, Mass., is doing a vast amount of work in the way of improving its sewers.

P. J. McCann, of West Superior, Wis., has been appointed sewer inspector of that city.

Willimantic, Ct., has awarded large sewer contracts to A. Brazos & Sons, of New Haven.

Bangor, Me., is laying about 1,000 feet of new sewers on Pickering and Haymarket streets.

The work on the sewerage system at Waltham, Mass., is progressing very satisfactorily.

A 1,450 foot sewer is to be constructed on Main street, Ottawa, Ill., at a cost of $2,323.56.

The city council of Minneapolis has ordered 94,629 feet of sewers for that city next year.

A sewer 225 feet long and four feet in diameter is being built in Spring street, Peoria, Ill.

The Hamilton street sewer is to be extended from Lee to Perry streets, in Saginaw, Mich.

A new sanitary sewer is to be built in West Denver, Colo., at an estimated cost of $126,286.

John E. Bretz has been awarded the contract for building the Main street sewer at Carlinville, Ill.

Three more sections of the North Metropolitan sewerage system of Boston have been allotted.

Sewers are wanted badly at Salem, Ohio, as there is practically no system of sewerage in that city.

The Yellow Mill trunk sewer has been a source of much trouble in the city of Bridgeport, Conn.

A recommendation to build the famous Baldwin street sewer, was adopted by the council of Oshkosh, Wis.

L. L. Dean, secretary of the sewer commission, at Amsterdam, N. Y., advertises for bids for the construction of sewers in Meadow and Elizabeth streets.

Two sewer contracts have been awarded recently in Trenton, N. J., to James Meara and Thomas J. McGovern.

W. P. Alsip was awarded the contract for the new city sewer system at Grand Forks, N. D., to cost $43,000.

The sewer through Railroad avenue, from Oak to Fifth streets, was laid at a cost of $7,239.30, at Oakland, Cal.

The contract for furnishing sewer pipe for the Stockton, Cal., sewers was let to the Stockton Terra Cotta Works.

The Hume street pipe sewer contract was awarded to William Fuller by the executive board of Rochester, N. Y.

J. W. Dunn, of Allegheny City, Pa., has received a contract for the construction of sewers at Corry, Pa., to cost $65,000.

It is thought that the $8,000 appropriated for the construction of the Mosher street sewer, Holyoke, Mass., will be insufficient.

Fred E. Shaw received the contract for building the Washington street sewer at Providence, R. I. It is to be 1,700 feet long.

P. J. Kain has been awarded the contract for the construction of a fifteen inch sewer in Alton, Ill. Sewer to be some 900 feet in length.

The Orange County Medical Association of Santa Ana, Cal., is discussing the vital necessity of a complete sewerage system for that city.

The Boughten Engineering Company, of Cincinnati, have been awarded a $17,621.67 sewer contract by the council of Findlay, Ohio.

The common council of La Fayette, Ind., let a pipe sewer contract to the Wallace Brothers, and a ten-foot brick arch with stone walls to Joshua Chew.

The work on the sewers of Port Jervis, N. Y., is being pushed with great rapidity, and they will doubtless be finished and ready for use long before the time originally fixed by the contractors.

The board of public improvements of Findlay, O., have recommended that the bid of George Weisickle be accepted for sewer work, at a cost of $20,046.41.

The city council of Kearney, Neb., has allowed the contract to W. L. Scott for building a large storm sewer in which the Union Pacific is jointly interested.

The council of Mankato, Minn., has ordered that the sewerage system be extended over half a mile at an estimated cost of $6,000, the work to be done by contract.

The contract for paving and sewering Sixth street, from Rosabel street to the Sixth street bridge, St. Paul, Minn., was awarded to Louis E. Shepley for $28,346.

It is necessary for the Lake Shore Foundry Company, at Cleveland, to cast an entirely new lot of sewer pipes to fill its contract with the city of Winona, Minn.

The Northwestern Sewer Pipe and Tile Company will soon commence operations at Riverside, Ia. The company has a first-class plant, representing an investment of $80,000.

The citizens of the Fourth and Fifth wards of Kansas City, Mo., are determined in their demand for the completion of the O. K. creek sewer and have appointed a committee of five to push the work forward.

Under ordinances 158 and 159, passed by the city of Quincy, Ill., new sewers are to be built on Twelfth, Main and Fourteenth streets, contracts for which were awarded T. J. Shea.

It is estimated that 1,000,000 bricks will be used in the District of Columbia the ensuing year in the building of new sewers and a firm at New Cambridge has been awarded the contract.

Sealed proposals will be received at the office of the board of control, No. 5 City Hall, September 23, for the construction of a sewer in Hamilton street, between Marquette street and Case avenue, Cleveland, O.

Sealed proposals will be received until Sept. 18, by the board of public works at Des Moines, Ia., for: Twelve-inch pipe sewer on Tenth street, from Mulberry street south to the alley; twelve inch pipe sewer on Tenth street, from Walnut street south to a point ten feet south of the alley; a twenty-one inch and fifteen-inch pipe sewer on Seventh street, from School to North streets.

WATER-WORKS.

Oil City, Pa., is to have a system of water-works.

Eaton, Ohio, is to have a system of water-works.

Kansas City is soon to acquire a system of water-works of its own.

Work has commenced on the water-works system at Oakland, Neb.

About $306,000 will be spent to improve the Youngstown, Ohio, water-works.

Duluth, Minn., has voted in favor of issuing $800,000 bonds to erect a water-works plant.

Nearly two miles of new water-pipe has been added to the water-works at Bay City, Mich.

The matter of purchasing hydrants is being considered by the council of Kokomo, Ind.

Machinery will be in demand for the boring of an artesian well at Wills Point, Tex. Address N. A. Matthews.

The present capacity of the water-works at Winona, Minn., is 12,000,000 gallons per day, and is considered insufficient.

The contract for the construction of the Deming water-works has been let to Messrs. Laird & Berg, of Deming, N. M.

At Kansas City, Mo., a water-works tunnel under the Missouri river will be built at a depth of about one hundred and thirty feet.

The superintendent of the new water works at McKeesport, Pa., will give details of the twe 3,000,000 gallon pumps required there.

A "clear water" system will be added to the water-works at La Fayette by the National Water-Works Supply Co., of Cincinnati, O.

The Dow Compound Pump, will be used in forcing the water into the East Oakland, Cal., reservoir by the Contra Costa Water Company.

The Fort Wayne, Ind., water-works are being extended. Seven hundred tons of pipe are being delivered and distributed over the various routes that mark the extensions to be made.

The water-works department, at Seattle, Wash., has 125 men employed on the extension of the mains, and work is progressing rapidly.

The Smedley Manufacturing Company, of Dubuque, Iowa, have the contract for putting in system of water-works at Winnebago, Minn.

Mr. George Morgan has drafted plans and specifications for a system of water-works and electric lights for the city of Metropolis, Ill.

Bonds will be issued to the amount of $452,000 for water-works at Elsinor, Cal., election having been held and votes cast in favor of same.

The National Pipe Foundry, of Scottsdale, Pa., has received the contract to furnish the pipe for the extension of the Blairsville water-works.

The city council of Ballingor, Texas, has received bids for a system of water-works, and a contract has been let to Drennen & Lee, of Waco, at $14,500.

Work has commenced on the extension of the Spokane, Wash., water system and trenches are being dug for the laying of 1,800 feet of 16-inch pipe.

A new water company has been organized with $300,000 capital stock, to supply Oakland, Cal., and suburbs, with water from the Piedmont Hills.

Waterville, Wash., is to have a system of water-works. Engineer H. K. Owens, of Seattle, has taken the contract at an estimated cost of $20,000.

Bonds have been sold for the extension of the Omaha water-works. The extension, with the present mains, will afford ample fire protection to the city.

Winona, Minn., is negotiating for new pumping machinery at the water-works, the present pumping capacity being only 12,000,000 gallons per day.

The board of trustees of the water-works at Toledo, O., have let the contract for the 15,000,000-gallon pumping engine to Henry W. Worthington, of New York.

With the exception of Louisville, the Owensborough Water-works have the finest pump in the state of Kentucky, with a capacity of 3,000,000 gallons per day.

The citizens of Santa Rosa, Cal., are pondering over the proposition to bond the city in the sum of $80,000 for the purpose of putting in a new system of water-works.

The water company, of Napa, Cal., has put in meters at all the livery stables, so that the company will know hereafter exactly how much water is used by each stable.

New York is laying a new water-main from the Ridgewood reservoir to the lower part of the city at a cost of about $650,000. The total length will be more than six mile .

The bids received for the proposed water mains were considered excessive by the board of water and lighting commissioners at McKeesport, Pa., and action has been deferred, with a probability that new bids will be asked for. Write to the secretary of the board.

The city council of Huntsville, Ala., will receive sealed bids until the 20th day of September, for the erection of a Compound Condensing Duplex Pump, with a capacity of three million gallons in twenty-four hours, against 175 foot head, and boiler to operate pump.

J. M. Low & Co., of Kingslon, have been granted a $250,000 franchise by the common council of Plainfield, N. J., to erect and maintain a system of water-works in that city.

Arrangements for the placing of new machinery and the boring of the proposed well on the site lately purchased by the Charleston (S. C.) Water-works Company are being made.

Two new Gaskill engines are to be used at the Sixty-eighth street pumping station for supplying the World's Fair with water. They will be operated at a pressure of ninety pounds because the World's Fair directors want a fire pressure all the time.

The water-works company at Marion, Ind., is building a new cistern which is calculated to hold 186,000 gallons, and is to be connected from the bottom with the pumping well with ten-inch sewer pipe. The supply of water in that city has been somewhat insufficient this summer.

BRIDGES.

The Westside bridge is completed at Olympia, Wash.

A two-span iron bridge will be built across the Republican river at Inavale, Neb.

Oregon, Ill., is talking of erecting a new steel bridge over Rock river at that place.

A two-span iron bridge will be built across the Republican river at Inavale, Neb.

Work on the new Leeper bridge at South Bend, Ind., is being pushed rapidly.

A new iron bridge is to be built at Riverton, Va., by the Richmond and Danville Road.

A new iron bridge has been delivered and placed over Yellow creek, in West Argentine, Mich.

Nicholas Feyn was awarded the Lexington avenue bridge contract for $6,866.24 at Minneapolis, Minn.

The Smith Bridge Company, of Toledo, Ohio, has been let the contract for an iron bridge at Canton, Ill.

The bridge which is being built at Toledo, O., will cost $15,000, and promises to be a handsome structure.

Minneapolis is going to construct a $6,000 stone arch bridge across Minnehaha creek, on Lyndale avenue.

A $118,220 viaduct is to be built on Ogden avenue, Chicago, by the American Bridge Works, of Chicago.

The road commissioners are figuring on a new iron bridge to span the Kishwaukee, on West Main street, DeKalb, Ill.

The Central Railroad of New Jersey will build a draw bridge over the Shrewsbury river at Neversink Highlands, N. J.

Work is begun on the Pennsylvania railroad bridge a few miles east of Maples, Ind. H. W. Tapp is the contractor.

S. M. Hewitt & Co., of Minneapolis, have been awarded a $4,520 contract to place a bridge across the river at Duluth, Minn.

The proposition of I. W. Livezey & Co. to furnish all the lumber required by the Newport and Covington Bridge Company in quantities necessary at $20 per 1,000 feet, for a period of one year, h been accepted.

The San Francisco Bridge Company received the contract for the building of the new Post street bridge at Spokane, Wash.

Columbus, Ohio, is to construct a Fifth avenue bridge across the Olentangy river. The Columbus Bridge Company is to do the work.

The Clinton Bridge and Iron Company have been notified to begin work at once on the Black river bridge at McGilvray's Ferry, Wis.

Bids will be received until September 19 for the erection of a bridge across Dog river at Walkins, Ga. H. T. Cooper will give details.

A bridge 53 feet high and 370 feet long, is to be built by the Upper Bridge Company, across the Monongahela river at Pittsburgh, Pa.

Specifications for the bridge to be built at South Meriden, Ct., will soon be completed by Engineer Clark, and bids will then be advertised for.

The Youngstown Bridge Company was awarded the contract for a new bridge on East Federal street, in Youngstown, which is to cost about $63,000.

The plans for the C. & W. H. extension bridge, at Charlevoix, Mich., have been approved, and it will be built by the Detroit Bridge and Iron Works Co.

The clerk of Tajiguas, Cal., has been instructed to advertise for plans, specifications, etc., for the erection of a bridge at that place, until September 28.

The board of commissioners of Hesa county, Colo., have appropriated $15,000 for the construction of a state bridge across the Grand river near De Beque.

A $36,000 contract for the erection of Division street bridge was let by the board of public works at Spokane, Wash., to the San Francisco Bridge Company.

There is to be a large wagon bridge span the Mississippi at Winona, Wis. The Chicago Bridge and Iron Company was awarded the contract for $94,700.

The Groton Iron Bridge Co. was given the contract to place a 620-foot bridge across the San Marcos river at Prairie Lea, Tex., at an estimated cost of $4,730.

A handsome steel suspension bridge, modeled, as far as practicable, after the famous Brooklyn bridge, is to be erected across Golden Gate, San Francisco, Cal.

Ninety thousand dollars have been appropriated and Commissioner Graham is preparing a schedule of repairs needed on the different bridges at Milwaukee, Wis.

A bridge 750 feet long is being constructed at Ashland, Wis. Contractor Whitney expects to have it completed and ready for use at the end of twenty-five days.

The Cascade City Land Company, of Cascade City, Wash., let a contract to C. O. Squire to build two bridges across Kettle river in British Columbia, just across the line.

The Southern Bridge Company, of Birmingham, Ala., has been given the contract for the new bridge to span the water of old Elk at Elk River Mills at that place.

R. D. Wheaton & Co., of Chicago, will construct a new iron bridge over the Pecatonica on the town line between Wayne and Gratiot, Ill. The bridge is to cost $3,230.

The Union Pacific is constructing a steel railroad bridge across the Columbia river at Vancouver, Wash. The length from the Washington to the Oregon shore will be 6,000 feet. The cost will be over $4,000,000.

The Georgia, Carolina and Northern road have just completed a large bridge over the Oconee river at Athens. It is 887 feet long, 85 feet high, and is one of the most imposing structures of the kind in Georgia.

By January 1st, Contractor Cornelius, thinks the Fifteenth street bridge, at Great Falls, Mont., will be completed. The superstructure will be delivered by the Wrought Iron Bridge Company, of Canton, Ohio.

Work on the bridge that is to span the Ohio river some three miles above Evansville, has commenced. It is being built by the Huntington syndicate, which has recently come into possession of the Ohio Valley Railroad.

It is claimed that Colorado is a considerable distance in the lead in the matter of good and substantial bridges, from the fact that it has been compelled to put in metal structures where wooden ones would have answered on account of the high price and poor quality of lumber.

Plans and specifications will be received until Sept. 20, for the construction of an iron truss bridge and its foundations across Grand river at the town of Debeque, Colo. The appropriation for the bridge is $14,000. The general specifications, plans of alignment and cross-section of the river, etc., are on file at the office of the state engineer, Barclay block, Denver.

Sealed proposals will be received at the office of the county auditor, Columbus, Franklin county, Ohio, on Monday, September 28, for furnishing material and performing the work of building a bridge over Indian Run, in Washington township. The estimated quantities of masonry and fill are as follows: 154-4 perch of limestone masonry, 50 cu. yds. of excavation, 800 cu. yds. of fill, 44 lineal feet of bridge.

STREET LIGHTING.

Portland, Conn., is to be lighted by electricity.

Weedsport, N. Y., has voted to light its streets by electricity.

Oliphant, Pa., is agitating the question of electric street lighting.

L. Lusk has the franchise for putting in an electric light plant at Riverside, Ill.

The Hagerstown Silk Mills Co., of Hagerstown, Md., will put in an electric light plant.

The council has granted A. B. Cockerill a franchise to erect an electric light plant at Weir, Kan.

Sixty arc lights are to be erected at Pontiac, Mich., for the purpose of lighting that city by electricity.

The council of Aledo, Ia., passed an ordinance granting a franchise for an electric light plant for that city, work to begin at once.

A resolution, granting a franchise to J. G. Gardner to establish and maintain an electric light works in Santa Rosa, Cal., has been passed.

The city council of Marion, Ind., have decided upon putting in a plant for electric lights. One hundred arc lights will be used at the outset.

The Wheeling Electric Light Commission have decided to adopt the Fort Wayne system. The bid of the company for erecting a plant to light Wheeling, W. Va., is $83,400.

The contract for building the waterworks and electric light plant at Union, Tenn., has been awarded to Messrs. Guild & White, of Chattanooga. Estimated cost, $54,000. Seventy street lights are to be erected.

SEALED PROPOSALS.

NOTICE TO STREET CONTRACTORS.

Sealed proposals will be received by the Common Council of the city of Terre Haute, Ind., Tuesday evening, September 29, 1891, for the improvement of Sixth street, by paving with brick and curbing with stone. Approximate length, 6,000 lineal feet; roadway, 36 feet wide.

Also, for the improvement of Wabash avenue, as above. Approximate length, 5,800 lineal feet; roadway, 50 feet wide.

Plans, specifications, etc., on file in my office.

Council reserves the right to reject any or all bids. Certified check for $2,000 to accompany bids.

FRANK H. COOPER, City Engineer.

NOTICE TO BIDDERS.

Notice is hereby given that sealed proposals will be received by the common council of the city of Attica, Indiana, at the office of the clerk of said city, up to 6 o'clock P. M., of Monday, September 21, 1891, for building concrete walks on both sides of Perry (or Fourth) street, from the south side of Ferry street, to the north side of Mulberry street, in said city, according to plans and specifications therefor on file in the office of the city civil engineer of said city. Said work to be done to the approval of said engineer and common council. Said proposals must specify the price per running foot for said improvement work, to include both sides of said street.

M. F. MILFORD,
City Civil Engineer.

NOTICE TO BIDDERS.

Notice is hereby given that sealed proposals will be received by the common council of the city of Attica, Indiana, at the office of the clerk of said city, up to 6 o'clock P. M., of Monday, September 21, 1891, for the grading, graveling, guttering and bouldering of gutters of Brady street from the north side of Pike street to the south side of Bond street, in said city, and for concrete sidewalks five (5) feet wide on each side thereof, according to plans and specifications therefor on file in the office of the city civil engineer. Said work to be done to the approval of said engineer and common council. Said proposals must specify the price per running foot for said improvement work, to include both sides of said street.

M. F. MILFORD, City Civil Engineer.

NOTICE TO BIDDERS.

Notice is hereby given that sealed proposals will be received by the common council of the city of Attica, Indiana, at the office of the clerk of said city, up to 6 o'clock P. M., of Monday, September 21, 1891, for the improvement of Jackson street in said city, by graveling said street from Brady to Broad street and by concrete walks five (5) feet wide on each side thereof from Perry to Broad street, except on the north side of said Jackson street from the east line of College street to Broad street, according to plans and specifications therefor on file in the office of the city civil engineer of said city. Said work to be done to the approval of said engineer and common council. Said proposals must specify the price per running foot for said improvement work, to include both sides of said street.

M. F. MILFORD,
City Civil Engineer.

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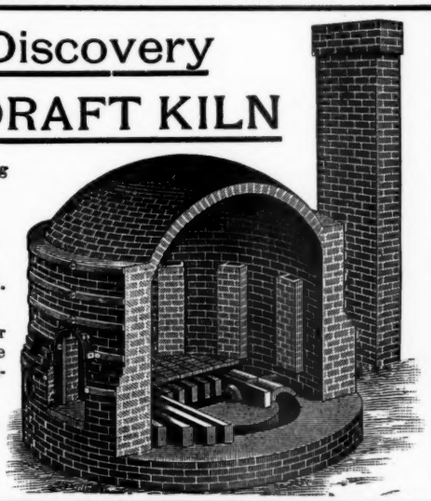

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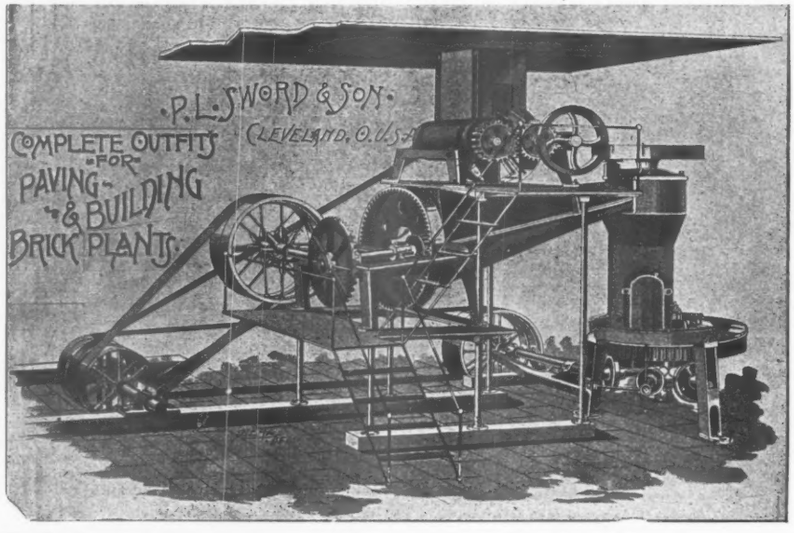

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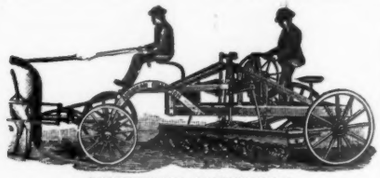

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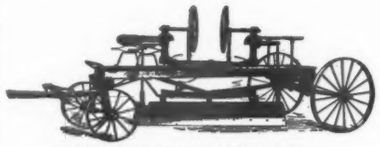

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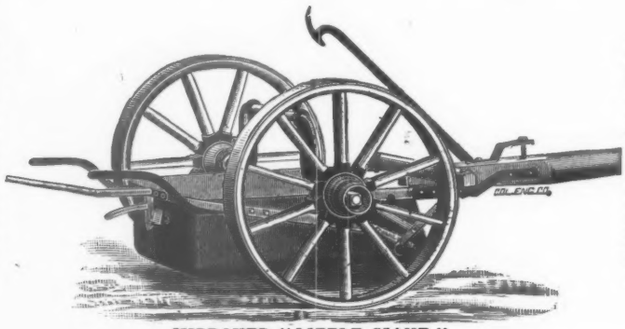

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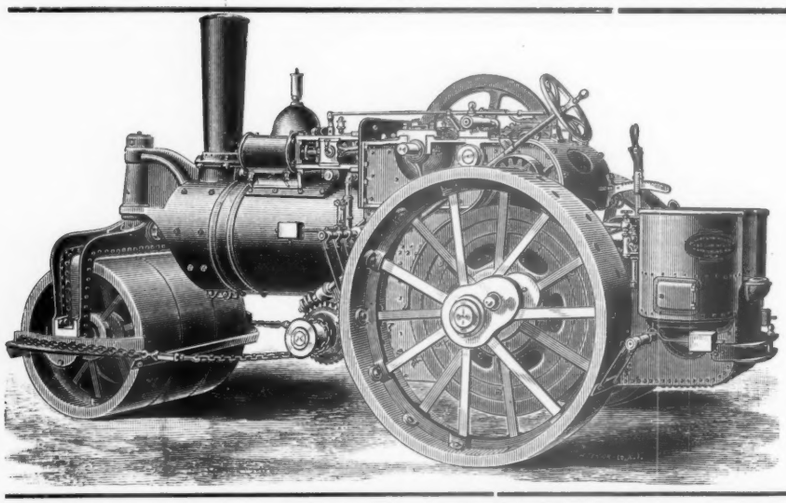

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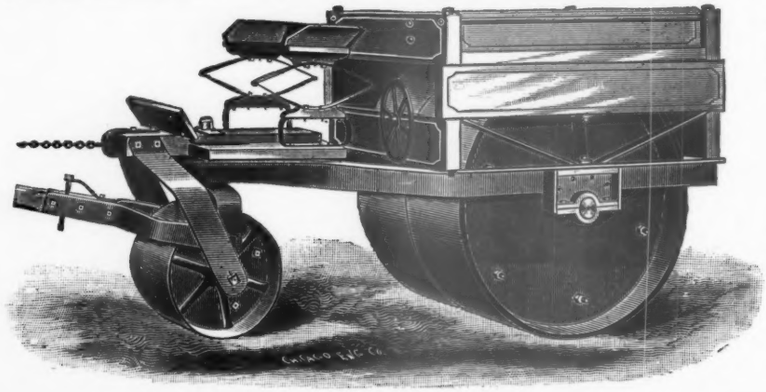

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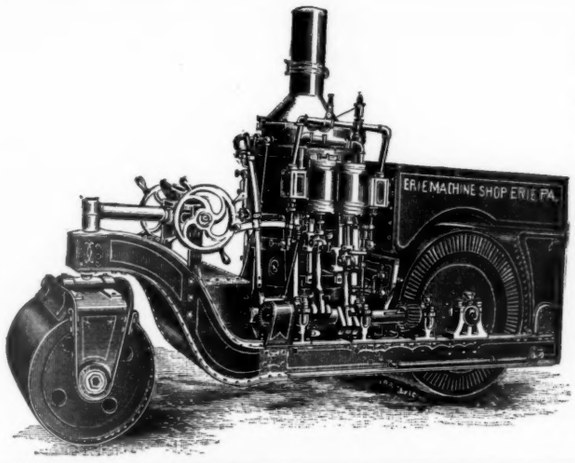

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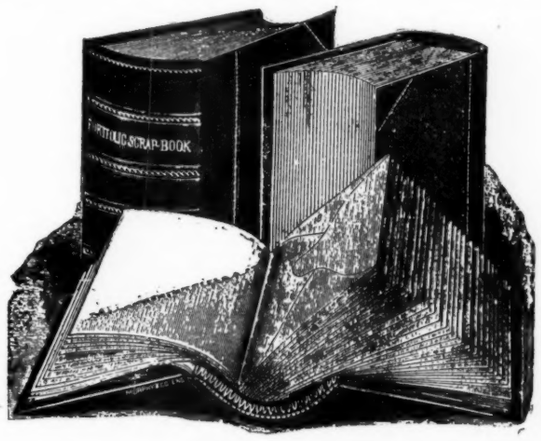

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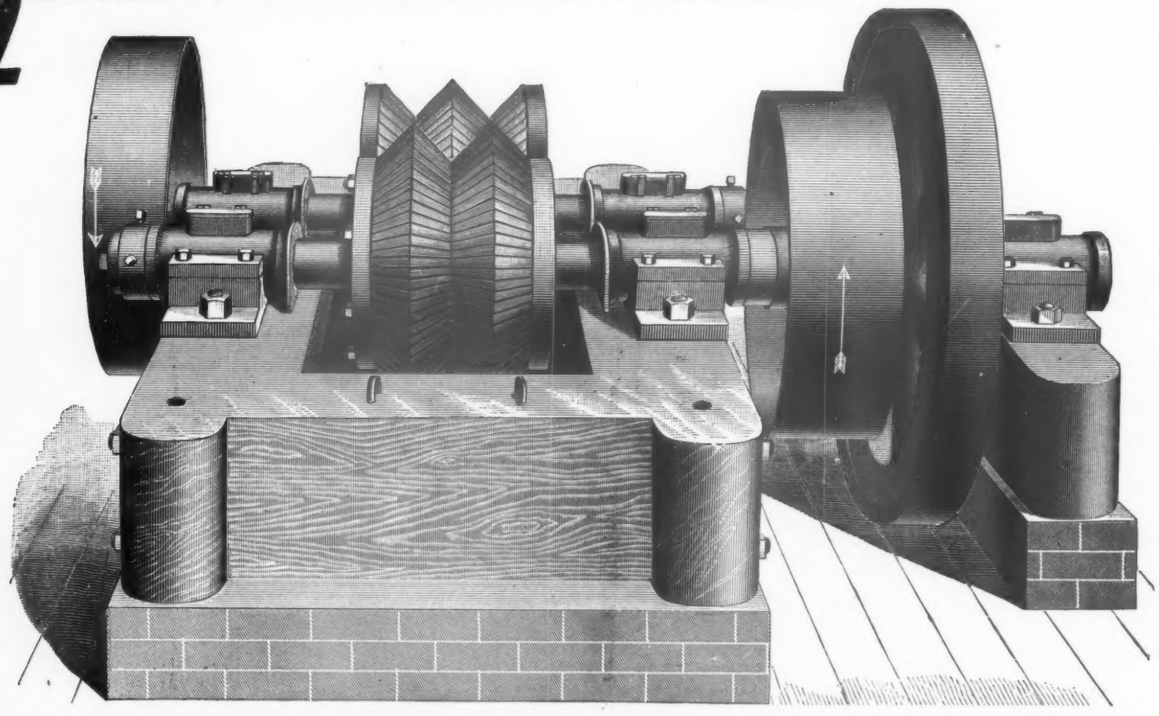

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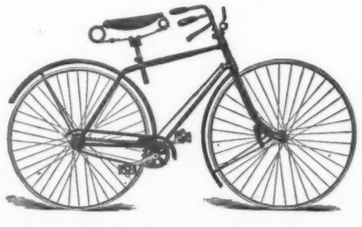

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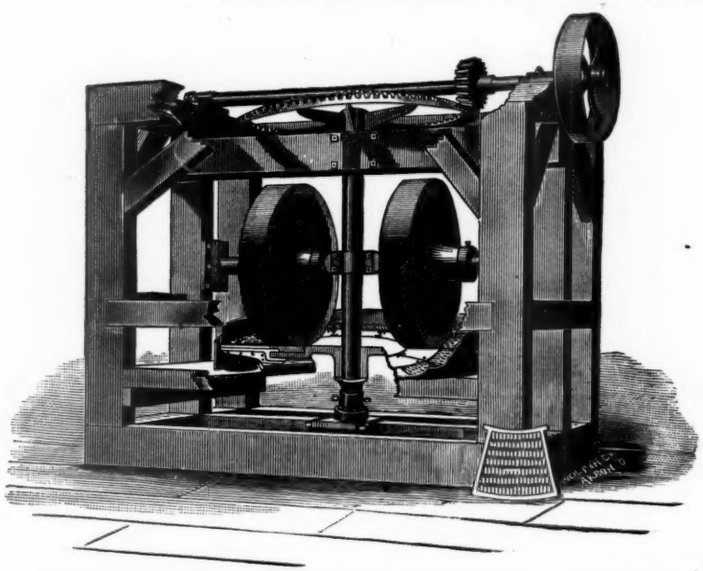

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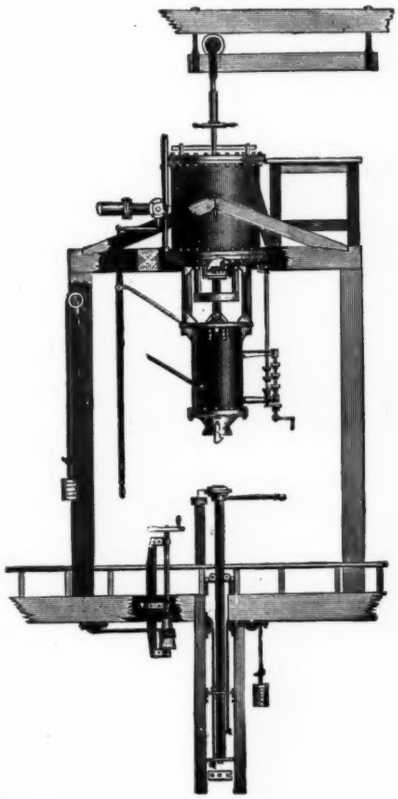

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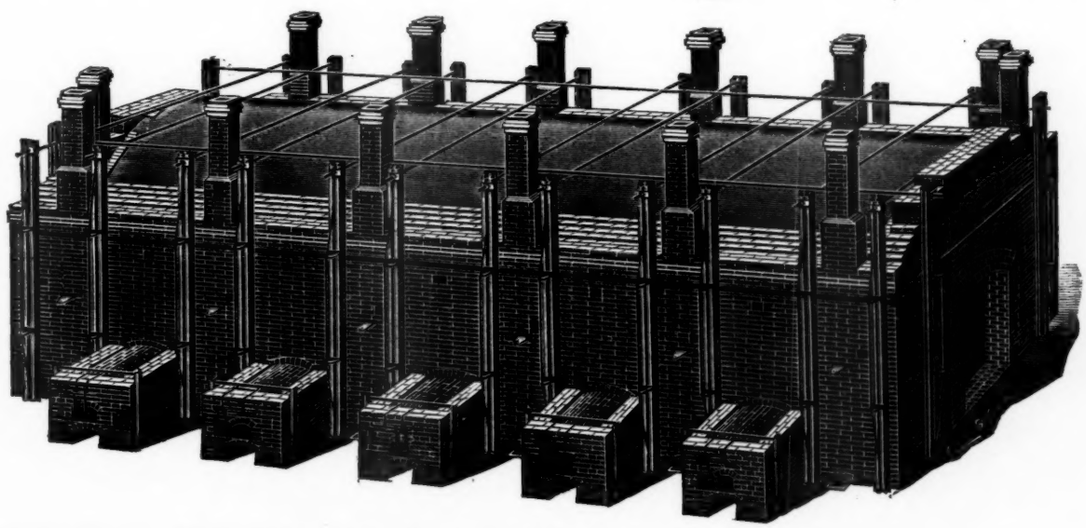

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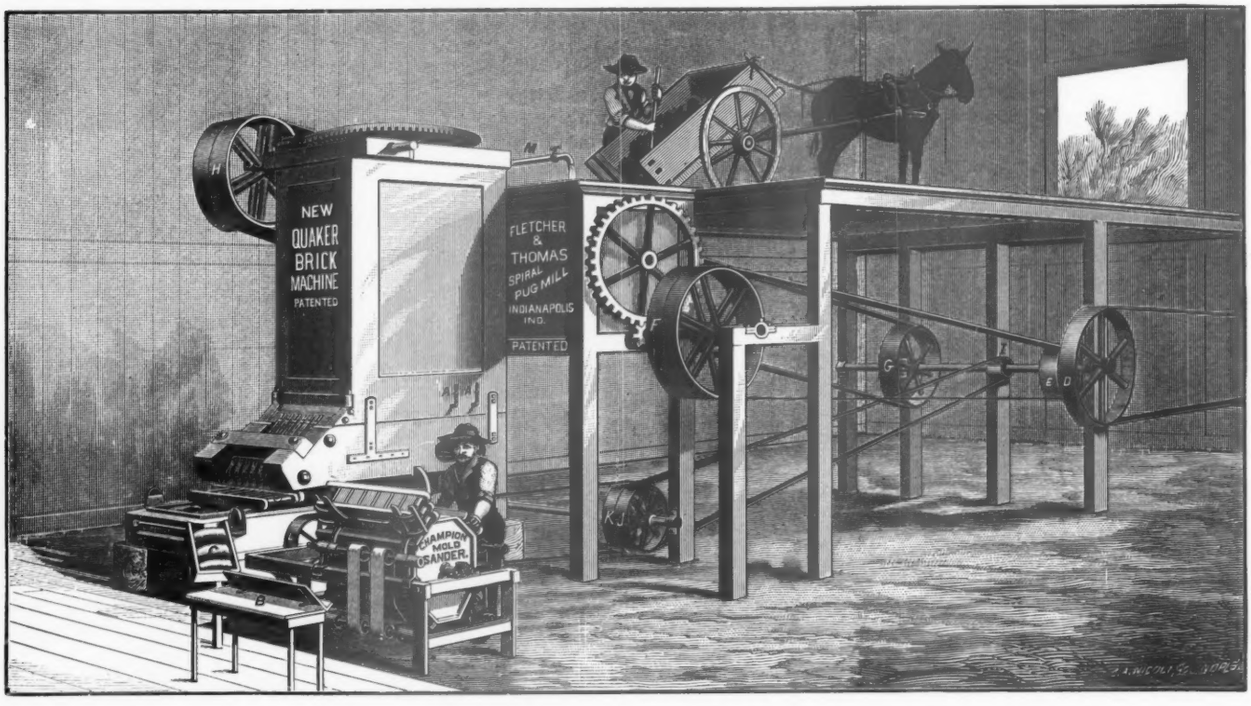

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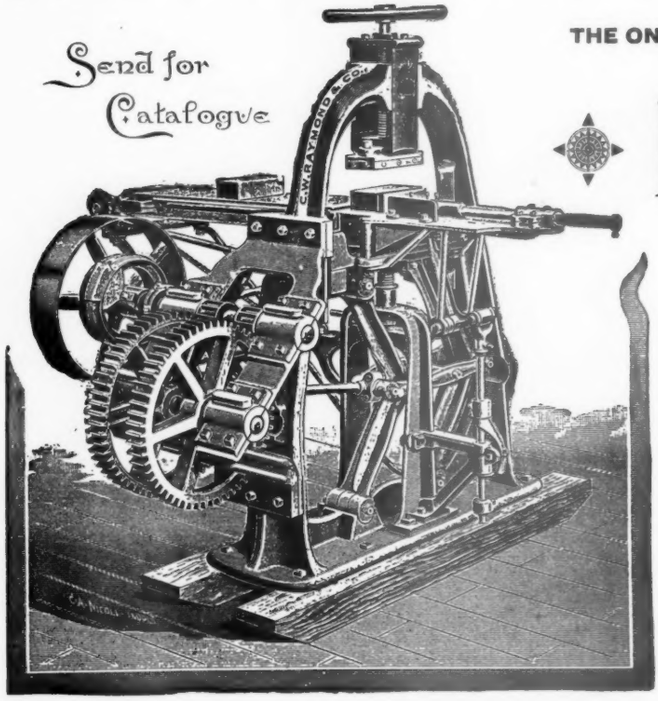

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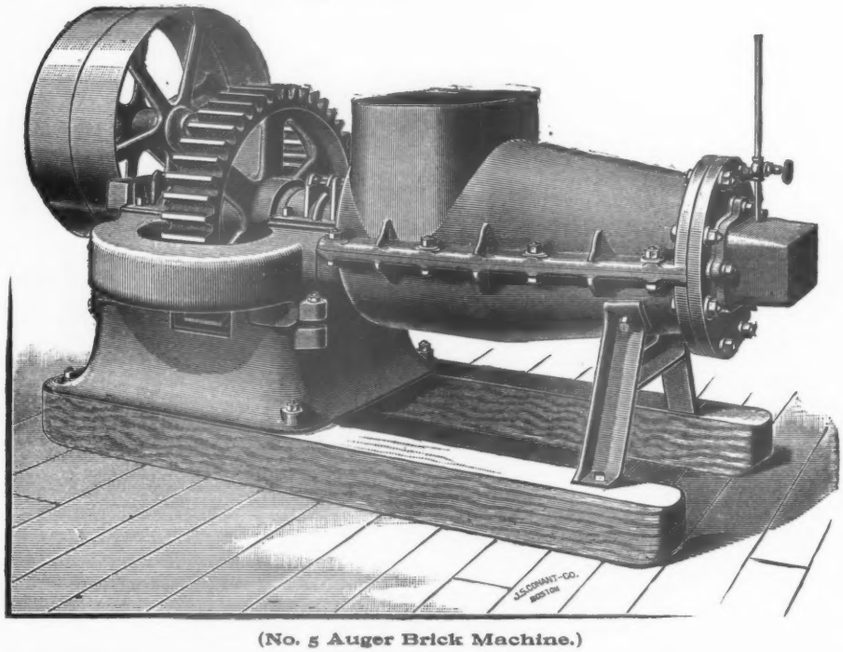

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